

## REMARKS

Claims 1-10 are pending in the Application and have been rejected. No amendments have been made in this response.

### 1. **Rejections Under 35 U.S.C. § 103(a) as Being Obvious Over Smalley in View of Jin**

The Examiner has rejected Claims 1-10 under 35 U.S.C. § 103(a) as obvious over Smalley et al., US Pub. 2002/0085968 ("*Smalley*") in view of Jin et al., U.S. Patent 6,465,132 ("*Jin*"). Final Office Action at 2. Applicant respectfully traverses the rejection.

The Examiner combined the teachings of *Smalley* regarding a "felt" of carbon nanotube ropes (paragraph 89, page 7) with the teachings of *Jin* regarding the use of carbon nanotubes in electron emitters (Figure 6, item 112; column 12, line 63 through column 13, line 3). Applicant contends that this is not a proper combination of references. A person skilled in the art would not combine the teachings of *Jin* regarding aligned nanotubes with the teachings of *Smalley* regarding tangled, non-aligned nanotubes.

Claim 1 requires, *inter alia*, a "carbon nanotube particulate" comprising "entangled small-diameter carbon nanotubes arranged in a three-dimensional network . . . wherein the carbon nanotube particulate has a cross-sectional dimension in a range of about 0.1 micron and about 100 microns."

*Smalley* teaches a tangled collection of single-wall carbon nanotube ropes stuck together in a felt or mat having sizes of  $10^2$  mm,  $100^2$  mm,  $1000$  mm<sup>2</sup> or greater. (See *Smalley*, page 7, paragraph 89.) These sizes of felts or mats are much greater than the cross-sectional dimension of the claimed carbon nanotube particulate, which is in the range of about 0.1 micron to about 100 microns.

*Smalley* also teaches several other forms of carbon nanotubes. For example, it describes short, closed tubular carbon molecules that are prepared by cutting longer carbon nanotubes. (Paragraph 106, page 8.) *Smalley* also describes carbon nanotubes that are chemically derivatized at their ends. (Paragraph 127, page 10.) It also discloses two-dimensional arrays of single-walled nanotubes that are aggregated in substantially parallel orientation. (Paragraph 149, page 12). It also teaches a macroscopic carbon fiber which is made up of an aggregate of a large number of single-wall nanotubes preferably in generally parallel orientation. (Paragraph 190, page 15.) Out of all of the many different forms described by *Smalley*, the Examiner has selected the felt or mat described in paragraph 89.

*Jin* teaches “nanowires” such as carbon nanotubes. (Column 4, lines 64-66; column 1, lines 29-32.) *Jin* does not teach or suggest a “carbon nanotube particulate” comprising “entangled small-diameter carbon nanotubes.” In fact, *Jin teaches away* from tangled structures, and, instead teaches the advantages of substantially aligned and parallel nanowires.

This invention provides an advantageous method for growing nanowires in a substantially aligned and parallel fashion.

(See *Jin*, at Column 5, lines 41-43)

The Examiner has argued that in *Jin* “the nanowires are formed in bundles, i.e. like ropes, suggesting that they would become somewhat entangled, especially due to the deviation of the nanowires.” (Final Office Action at 5.)

Applicant respectfully traverses the Examiner’s speculation that the nanowires of *Jin* “would become somewhat entangled.” In fact, the problem of entanglement is one of the most critical obstacles that *Jin* has claimed to overcome. (See column 3, lines 1-6, where *Jin* discusses unaligned or tangled nanowires as a problem to be solved; see also the repeated description by *Jin* of the nanowires of his invention as being aligned, e.g., at column 4, lines 15-

19 and 56-59, and column 5, lines 31-43.) *Jin* also notes that “Each one of the plurality of nanowires can be substantially vertically aligned relative to the substrate and preferably, the average deviation from full vertical alignment is less than 25 degrees, and more preferably less than 15 degrees.” (*Jin* at Column 3, lines 61-65) However, Applicant notes that **none** of the teachings of *Jin* suggest entanglement. Figures 4A and 4B in *Jin* illustrate parallel nanowires (28) that are vertically aligned from a surface, and parallel nanowires that are positioned in an angled direction relative to the surface, respectively. (See column 10, lines 24-29.) Even though the nanowires are not perpendicular to the surface in Figure 4B in *Jin*, the nanowires are still parallel and not tangled. Thus, an angular deviation relative to vertical of the nanowires from a surface does not in any way suggest, imply or require entanglement of the nanowires. See also Figure 6 of *Jin* in which the plurality of nanowires (112) is shown in a parallel and vertical configuration. There is no teaching or suggestion in *Jin* that the nanowires are in any way entangled, such as claimed in the present invention.

Applicant further notes that in *Jin*, there are two aspects of alignment, namely, the alignment of the nanowires, and secondly, the alignment of the nanowires on the surface. In the first alignment issue, *Jin* makes it clear that the nanotubes are aligned parallel to each other. Applicant would also respectfully note that *Jin* appears to use the word “particles” in different way than the present claims. *Jin* appears to use “particle” to refer to individual aligned nanotubes, rather than referring to a three-dimension structure that comprises a number of nanotubes. (See *Jin*, at Column 4, line 64, to Column 5, line 1).

The second alignment issue in *Jin* is the alignment of the individual nanowires on a surface. *Jin* teaches that the nanowires can be located at an angle to the perpendicular with respect to the substrate, as in Figure 4B, but even in that situation, the nanowires are aligned

with, and parallel to, each other. For example, *Jin* describes “the formation of nanowires . . . that are vertically aligned.” (*Jin* at Column 4, lines 56-59.) *Jin* further teaches that “tangled nanowires are not suitable for various applications . . . as they can cause sideways electrical shorting between adjacent contact pads.” (See *Jin* at Column 5, lines 31-40.) *Jin* further states “[t]his invention provides an advantageous method for growing nanowires in a substantially aligned and parallel fashion.” (See *Jin* at Column 5, lines 41-43.)

An obviousness rejection based on a combination of references requires a motivation or suggestion to combine the references, coupled with a reasonable expectation of success. The motivation or suggestion must be in the prior art, in the knowledge of one of ordinary skill in the relevant art, or in some cases in the nature of the problem to be solved. *In re Huston*, 308 F.3d 1267, 64 U.S.P.Q.2d 1801, 1810 (Fed. Cir. 2002); *Boehringer Ingelheim Vetmedica, Inc. v. Schering-Plough Corp.*, 320 F.3d 1339, 65 U.S.P.Q.2d 1961, 1971-1972 (Fed. Cir. 2003). In this case, given the differences between the cited teachings of *Smalley* and *Jin*, no such motivation or suggestion to combine the references exists.

To be specific, the Examiner has relied on *Jin* as teaching the use of carbon nanotubes in electron emitters, but *Jin* emphasizes the importance of having those nanotubes aligned parallel to each other, rather than being in a tangled mass. Therefore, one of ordinary skill in the art would not have any reason to combine the emitter of *Jin* with the tangled “felt” of nanotubes taught by *Smalley*, since that structure would directly contradict the requirements taught by *Jin*. The only way one could arrive at the invention of Claim 1 with these two references is by using hindsight to pick and choose elements from the references. This of course is not proper § 103 analysis.

Therefore, in light of the foregoing, a *prima facie* case of obviousness has not been established for Claim 1 and, thus, the claim cannot be held obvious under 35 U.S.C. § 103(a). Likewise, Claims 2-10, which are dependent, either directly or indirectly, upon Claim 1, are also not *prima facie* obvious for same reasons as Claim 1.

Applicant respectfully requests that the Examiner withdraw the rejection of Claims 1-10 under 35 U.S.C. § 103(a) as obvious over *Smalley* in view of *Jin*.

## **2. Conclusion**

Applicant respectfully contends that claims 1-10, as presented herein, are now in condition for allowance.

The Examiner is invited to contact the undersigned attorney at (713) 934-4094 with any questions, comments or suggestions relating to the referenced patent application.

Respectfully submitted,

WILLIAMS, MORGAN & AMERSON, P.C.  
CUSTOMER NO. 23720

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/Kenneth D. Goodman/  
Kenneth D. Goodman  
Reg. No. 30,460  
10333 Richmond, Suite 1100  
Houston, Texas 77042  
(713) 934-4094  
(713) 934-7011 (fax)

ATTORNEY FOR APPLICANTS